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To: E. B. Sanders  
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Subject: Plans and Objectives for 1982 (Charge #2501)

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Charge #2501 has as its basic objective the investigation of smoke chemistry utilizing radiochemical techniques. Programs which will be ongoing during 1982 can be categorized briefly as follows:

1. Low Level Laboratory - Completion of the low level laboratory, including equipping of the facility, will occur in 1982. This facility will ultimately perform both service and basic research functions, though it is anticipated that only service work, namely environmental monitoring of various tobacco samples, will be initiated in 1982. Related to the low level laboratory is the project's work in health physics.
2. Precursor-Product Studies - The use of radiolabelled precursors to enable one to determine products formed on a burning cigarette, thereby developing an understanding of the smoke chemistry of the selected precursor, is the major role of Charge Number 2501. A number of specific studies of this type will be carried out in 1982 including investigations of the formation of carbon monoxide from labelled cigarette paper, the behavior of menthol on a labelled cigarette, formation of aza-arenes from nicotine, and the formation of volatile nitrosamines from nitrate and/or nitrite.
3. Transfer Of Inorganics To Smoke - This work constitutes a long term study regarding the mechanism of transfer of non-volatile substances to mainstream smoke.
4. Sidestream Smoke - Methods will be developed for the collection and analysis of sidestream smoke.

More detailed descriptions of the specific objectives for 1982 are given below.

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I. Low Level Laboratory and Health Physics

A. Low Level Laboratory

1. Finish construction of the low level laboratory to include:

- a. overseeing all aspects of construction leading to and including final building acceptance and occupancy
- b. evaluation, ordering and installing of necessary counting equipment in conjunction with outside consultants

2. Place purchased and on-hand counting equipment into routine operation to include:

- a. set-up and check-out of all equipment to insure proper operation-calibration standards required
- b. establishment of normal background radioactivity levels on natural samples (air, soil, water)
- c. establishment of techniques for determination of radioactivity levels in our products, raw materials, water supplies and effluents, etc.

3. Initiate a baseline radiochemical study for annual monitoring of tobacco crops in order to be able to measure year-to-year variability of natural radioactivity levels and thus be able to respond to changes as may be caused by natural and/or man-made disasters

B. Health Physics and Administration

1. Maintain all aspects of health physics for the Research Center to include:

- a. routine inspections of all areas of radiochemical useage to insure proper storage, handling and disposal of radioactive materials

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- b. training of personnel to insure their health and safety during all radiochemical activities
  - c. assurance of proper disposal of radioactive waste and its subsequent removal from the R&D area
2. Administer requirements imposed by virtue of possession of an NRC license to include:
- a. proper record keeping as required for health physics
  - b. maintenance of a library of pertinent and required texts, publications, etc.
  - c. continuous updating of information to insure compliance with all new NRC restrictions

## II. Precursor-Product Studies

### A. $^{14}\text{C}$ -Menthol Study

Cigarettes have been prepared to which  $^{14}\text{C}(\text{U})$ -menthol has been added. The cigarettes have been stored in individual vials and are currently being monitored for equilibration and transfer of menthol from filler to filter. Studies to determine the effects of different paper porosity, varied levels of dilution and varied total cigarette length on the menthol distribution and breakdown in smoke are to be conducted. In addition, the rate and final migration data from filler to filter will be determined. Comparisons of all data will be made with previously determined values from non-diluted, unfiltered  $^{14}\text{C}$ -menthol cigarettes.

### B. Aza-Arenes

A study to determine if nicotine is a precursor to the aza-arenes known to exist in cigarette smoke is to be conducted. Several memos detailing the major goals of the study and other means to accomplish these goals have been written. In particular the immediate directions to be followed require:

- 1. close co-operation between several projects on all aspects of the work

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2.  $^{14}\text{C}$ -tobacco plant production and isolation of  $^{14}\text{C}(\text{U})$ -nicotine from these plants
3. incorporation of highly purified  $^{14}\text{C}(\text{U})$ -nicotine into specified cigarettes, smoking of these cigarettes and isolation of the aza-arene fraction(s) from the WSC
4. receipt, installation, check-out and methods' development of capillary gas chromatographic instrumentation and techniques
5. development of methods for the sophisticated handling (heart-cutting, GLRC, splitting) of fractions containing potential  $^{14}\text{C}$ -labelled aza-arenes

C.  $^{14}\text{C}$ -Labelled Cigarette Paper

Cigarette papers have been prepared by Schweitzer Paper Company with and without citrate added and incorporating  $^{14}\text{C}$ -cellulose isolated from  $^{14}\text{C}$ -labelled stalk and stem from  $^{14}\text{CO}_2$  chamber grown tobacco. A study is to be conducted utilizing cigarettes made from these papers to investigate the effect of citrate on cellulose breakdown into smoke-particular emphasis is to be placed on the contribution to CO formation. Future plans include an extension of this study using papers prepared from  $^{14}\text{C}$ -citrate,  $\text{Ca}^{14}\text{CO}_3$  and  $^{45}\text{CaCO}_3$  and the determination of the contribution of each to the various smoke phases.

D. Puff-by-Puff Studies

Continue studies presently underway to investigate similarities and differences in the deliveries of various components within a puff and between selected puffs. Studies using cigarettes labelled independently with  $^{14}\text{C}$ -bright, -burley, and -Oriental tobaccos are being conducted to determine their contribution to the puff profiles.

E. Low Delivery Cigarettes

Continue studies underway in which  $^{14}\text{C}$ -bright, -burley, and -Oriental tobaccos are incorporated into selected low and ultra low tar cigarettes. Investigations center on delivery from the major cigarette components into smoke and the relation of the percent delivery to the original percentage in the cigarette: i.e., does each major component deliver its proportional share to the mainstream smoke?

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#### F. Volatile Nitrosamines

1. In conjunction with the aza-arene study, labelled nicotine and/or other nitrogen containing natural tobacco constituents will be isolated and utilized to determine their contribution to the volatile nitrosamines in cigarette smoke.
2. Methodology will be developed to interface the exit of a thermal energy analyzer with a mass spectrometer so that the ratio of  $^{14}\text{NO}_2$  to  $^{15}\text{NO}_2$  formed from the pyrolysis/oxidation of a nitrosamine can be determined.
3. Studies will be carried out using added  $^{15}\text{NO}_3^-$  and  $^{15}\text{NO}_2^-$  to various types of cigarettes to attempt to elucidate the mechanism of volatile nitrosamine formation.

#### III. Calcium -45 Studies

Conduct a series of studies utilizing tobacco grown hydroponically in nutrient solution containing  $^{45}\text{CaCl}_2$  to include:

- a) total smoke distribution of calcium - in particular the previously observed negligible delivery of calcium into mainstream smoke will be investigated as will the calcium contribution to the sidestream smoke
- b) determination of the filtration of calcium by the tobacco rod and by filters during smoking and comparison of this data with previously determined values for other inorganics
- c) assistance to the microstructure group in their studies on calcium location in leaf before and after curing and the effects of expansion on calcium distribution

#### IV. Sidestream Collection and Analysis

Initiate a program to effectively collect and analyze sidestream smoke (defined as that smoke generated in the 58 second interval between mainstream puffs). Some technology is available for individual cigarette SS collection from non-radioactive cigarettes but techniques for radioactive total trapping must be developed. The trapping of SS smoke from large

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numbers of cigarettes presents unique problems that must be addressed, particularly as to the handling of the mass of water generated and the safe treatment of the radioactivity in the smoke. The simultaneous collection of MS and SS is the third major area to be investigated in this program. Each component of the three areas requires the development of special techniques for trapping and handling. The ultimate long-range goal is to generate smoke data comparable to that reported by tobacco researchers in the past on mainstream cigarette smoke.

V. Miscellaneous

1. Continue studies directed at the incorporation of radioactive counting equipment onto capillary gas chromatographs.
2. Perform routine and non-routine radiochemical determinations for this and other projects and respond to other non-radiochemical inquiries as requested.

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